AMS 518: Advanced Stochastic Models, Risk Assessment, and Portfolio Optimization,

Fall 2022

Credits and Grading: 3 credits, ABCF grading

Instructor: Stan Uryasev, Math Tower 148 B, e-mail: stanislav.uryasev@stonybrook.edu
Office hours: Wednesday 10:00-11:00 with Zoom

Course Web Site and Blackboard: Refer to Blackboard, where course notes, articles, solutions and slides will be posted, and videos of lectures available through EchoCenter.

Lectures: Thursday, 13:15-16:05, online lectures with Zoom

Teaching Assistant: Cheng Peng, cheng.peng.1@stonybrook.edu
Office hours: Monday, 09:00-10:00 and Wednesday, 09:00-10:00

Text: The course notes cover the main material of the course. For better understanding of material, it is suggested to read original articles. Supplemental reading: Zabarankin, M. and S. Uryasev. "*Statistical Decision Problems. Selected Concepts and Portfolio Safeguard Case Studies."* Optimization and Its Applications, Vol. 85, Springer, 2014.

Prerequisites: Students are supposed to know basic statistics concepts (mean, variance, linear regression). Some knowledge of mathematical programming algorithms (linear programming, mixed-integer programming), if you do not know these concepts, be ready to catch-up (relevant chapters of standard text books will be provided). Basic knowledge of high-level programming environments: MATLAB or R (or a strong desire to learn). You should have the ability to do mathematical reasoning at the level of an undergraduate course on analysis (sets, inequalities, necessary conditions of extremum).

Technical Requirements
This course uses Blackboard (https://blackboard.stonybrook.edu) to facilitate communications between faculty and students, submission of assignments, and posting grades. If you are unsure of your NetID, visit https://it.stonybrook.edu/help/kb/finding-your-netid-and-password for more information. You are responsible for having a reliable computer and Internet connection throughout the term. The following list details a minimum recommended computer set-up and the software packages you will need to access and use:

Hardware:

– PC (Windows 7, 8, or 10) or Macintosh (OS X/macOS 10.10 or higher).
– 4 GB RAM.–A high-speed internet connection.
– Speakers (either internal or external) or headphones. Headphones are strongly recommended to reduce the risk of feedback during communications.
– Microphone (either internal or external).
– WebCam or other camera (interfacing with your computer) for producing video.

Software (additional tools may be needed). Remember to use your Stony Brook email or NetIDwhen configuring specialized software:

- An up-to-date Internet browser, such as Chrome, Firefox, Explorer/Edge (Windows), or Safari (macOS). A complete list of supported browsers and operating systems can be found on the MyInstitution page when you log in to Blackboard.
- PDF viewer, such as Adobe Reader.

- Zoom. Stony Brook has a site license for Zoom; you can find information on downloading, installing, and using Zoom https://it.stonybrook.edu/services/zoom/students

Exams: This class does not have exams. Grading is based on homeworks, project and attendance.

Homeworks: Homeworks covering main material of the course will be graded. Also, students will present solutions of some homeworks in the class. For homework problems, you are expected to write up your solutions *on your own*, **without referring to other students' writeups or to solutions you may find on the web**; you are welcome to discuss the problems with TA, and classmates, but **must do the writeup entirely on your own**.

Project: Every student will do a project and present in the class. The project (case study) should use learned numerical techniques. Also, students review projects of their peers and present the review report in the class.

Grades: We will use your total average score to assign a letter grade; there is no pre-established scale or curve. It is expected that 40-50% of students receive A/A-, and 40-50% receive B+/B/B- grades (with a few outliers having lower grades).

Assignment	Percentage of Final Grade
Homework	50%
Project	40% (see project requirements)
Project review	5%
Attendance	5%
Total	**100%**

Course Objectives
- Learn optimization approaches for quantitative systems with various constraints on budget, cardinality, transaction costs, buy-in and risk constraints
- Develop numerical skills to calibrate and optimize financial systems with uncertain outcomes.
- Conduct numerical case studies demonstrating process of finding optimal decisions.

List of Course Topics:
Every course topic covers financial background and numerical methods for solving the problem.

- Hedging (Linear Regression) with Budget and Cardinality Constraints
- Index Tracking (Linear Regression) with Transaction Costs, Buy-in and Risk Constraints
- Portfolio Replication with CVaR Constraints
- Quantile (Value-at-Risk) Regression: Style Classification of a Hedge Fund
- Conditional Value-at-Risk (CVaR or Expected shortfall) Regression/Estimation: Applications in Risk Management
- Risk Quadrangle: Combining Risk, Deviation, Error, Regret and Statistic
- Linear Regression with Heavy-Tailed Distributions

Student Accessibility Support Center Statement
If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Academic Integrity Statement
Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected

instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Professions, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management
Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of University Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.